Measurement of the Critical Properties of Several Endothermic Hydrocarbon Fuels

Yang Liu [S], Maogang He [C] and Ying Zhang
Xi'an Jiaotong University, MOE Key Laboratory of Thermal Fluid science and Engineering, Xi'an, Shaanxi, China
mghe@mail.xjtu.edu.cn

The critical temperature and the critical pressure of aviation fuels are important parameters in evaluating their combustibility. Fuels at supercritical states have advantages for combustion, such as high density, strong heat absorption ability, good dissolve capacity, and certain cage effect etc. So the experimental critical property data of endothermic fuels and high density fuels are necessary for the design of hypersonic engines. Aviation fuels are mostly complex mixtures which consist of linear hydrocarbons, alkenes, arenes and unsaturated hydrocarbons etc. The aviation fuels have poor thermal stability, and thermal cracking or thermalpolymerization would arose easily under high temperatures. At present, the experimental methods for measuring the critical parameters of thermally unstable substances include sealed ampule method, pulse-heating method and flow methods. The flow methods have a satisfactory heating time about ten seconds, and were proven to be suitable for measuring the critical temperature and the critical pressure of thermally unstable substances.

At present, large numbers of experimental data of organic compounds obtained by the flow method were reported. The literatures show that the measuring uncertainties of the critical temperatures and critical pressures were mainly within ±10K and ±2%. In this paper, according to the experiment principle of flow method, a critical properties measurement apparatus was established which consists of the experimental cell, temperature and pressure control system and data acquisition system of temperature, pressure and images. The measurement can be carried out up to 10 MPa for pressures and 773 K for temperature. The total uncertainty for pressure and temperature is estimated to be not greater than ±1.25kPa and ±0.08K, respectively. N-pentane and n-hexane were used as standard reagents to test the reliability of the apparatus. The results showed that the apparatus satisfied the design requirements. Then the critical properties of several endothermic hydrocarbon fuels, XJ-1 and XJ-2 etc. (the dominant sectors are alkanes), were measured.